R 111

Data registration and quality management on examination of high accuracy class weights

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The Verification Authority of Rhineland-Palatinate (located in Bad Kreuznach, Germany) owns an air-conditioned weighing laboratory equipped with seven comparator weighing machines, in which the examination (calibration or verification) of weights of accuracy classes F_1 and E_2 takes place using the substitution method in accordance with OIML Recommendation R 111.

In the laboratory the following weights are examined:

- Standard weights used by the Verification Authority for the verification of scales,
- Weights used by the chemical and pharmaceutical industry, and
- Weights used in the field of quality assurance.

Micro scale with 6 g maximum for the determination of weights of accuracy class E_2

To establish traceability to national standards and depending on the field of application, corresponding calibration or verification certificates are issued.

Up to the beginning of 1997, weighing results were determined manually. Measurement deviations of weights were found by comparison to corresponding nominal weights and the measured values obtained during the weighing cycle (standard weight - test weight - standard weight) were transcribed onto forms. The necessary calculations of the measurement deviations and measurement uncertainties were performed afterwards with the aid of the handwritten records, and then transcribed onto the corresponding certificates. However, the number of certificates to be issued increased continuously and so it became necessary to minimize the time spent on recording and calculating the data, and to eliminate possible transfer errors by automating the whole process.

With the company Maro-Elektronik a partner was found that had the ability to write a program for transferring weighing results data onto a computer.

So the calculation of measurement deviations and uncertainties dependent on the standard weights used in their corresponding accuracy class had to be performed based on automatically entered data of the values measured. Simultaneously, the certificates to be issued had to be produced by the computer.

The program was especially tailored to the requirements of the Verification Authority of Rhineland-Palatinate and has successfully been used for testing weights and drawing up certificates since March 1997.

In the meantime, with the professional support of a reputed weight manufacturer, Häfner Gewichte GmbH, Maro-Elektronik had extensively revised their software and now offers a complete hardware and software package called *Scales-net32*, which is designed for legal verification authority laboratories as well as for accredited calibration laboratories and weight manufacturers.

The package consists of several components: the basic version consists of a comparator weighing machine, a terminal, a climatic station, a PC plug-in-card and the PC software. The system can be expanded at any time.

This configuration is able to manage up to four climatic stations or data loggers and display on a monitor the ambient climatic data of all the climatic stations that are connected, as well as to store the data for documentation. For example, the first three inputs of a connected data logger having eight inputs can be used for room temperature, ambient air pressure and

air humidity, so that the remaining five inputs are available for the temperature sensors, which are incorporated in the comparators or scales. Defining which channel of the data logger is connected to which temperature sensor of a comparator or scale is achieved by adjusting the PC software. In this way, during the comparison the temperature in the weighing room can be registered. The climatic station continuously displays the room temperature on a four-digit display and therefore continuously indicates the actual values. If the temperature parameter that is set is exceeded by drift, this is signaled by a flashing LED display. At present, the system is able to manage 28 scale controllers and four climatic stations.

It is possible to connect to the system automatic and non-automatic working scales and comparator weighing machines with load changing equipment of various manufacturers (as well as those which are to be operated manually). The only necessity is to have a defined connection to the particular scale.

For the operation of the PC software, a Pentium 166 MHz or higher with Windows 95/98/NT is necessary.

The software provides all the relevant data that is required by the units (for example the climatic station and the comparator weighing machine with the scale). Also, the connections for the data import and export are designated in accordance with ASCII.

The comparator weighing machine consists of a micro-processor controlled input and output unit which enables the user to connect to the scale and PC software, and the user is guided in a straightforward way by a menu on the scale controller.

At the beginning of a weight comparison the user is asked to enter the required basic data, such as:

- Inspector,
- Scale registration number,
- Customer identification number,
- Order number,
- Serial number of the test unit set of weights,
- Nominal value,
- Accuracy class of the unit under test,
- Characteristic “point” or “star” for double weights,
- Shape of weights (for example: polygonal disk or cylindrical weight),
- Density or volume of the test unit, and
- Set of standards used.

After this data has been entered, the scale is tested to ascertain:

a) If it is suited to this nominal value or class, and
b) If the preset adjustments and fixed calibration time limits are not exceeded, and
c) If the standard weights used are qualified for their designation and if their recalibration time limits are not exceeded.

Micro scale with 6 g maximum and scale controller

This ensures that on a scale which, for example, is qualified for accuracy class E_2, an examination of an E_1 weight cannot be carried out - which consequently guarantees that on a scale with an expired calibration period, a weighing process cannot be performed.

It also means that in this enhanced examination program, the test equipment is also monitored in addition to the computation of the measuring results, in order to better ensure quality assurance. If the calibration and adjustment of the scale or the calibration of the sets of standards used is performed using *Scales-net32*, a statement relative to the quality progress of the scale or the standards can be made. If the scale or the data set is blocked, the user will be informed by the scale-controller. The release of the scale will be obtained by a new calibration or adjustment.

The user is asked to place the test weight on the scale pan and to confirm the selected type of weighing cycle on the comparator weighing machine: “Standard - test unit - standard” or “standard - test unit - test unit - standard”. After the scale has reached its position or after a certain lapse of time (for time-controlled weighing) the weighing data is automatically entered into the comparator weighing machine. On each weighing, the parameters detected (room temperature, air pressure, air humidity) are combined with the weighing data and the customer data.

After the predefined number of weighing cycles (depending on the accuracy class of the test unit) have been performed and the weighing process has been

Automatic comparator weighing machine for the determination of weights up to 50 kg of accuracy class E_2 with scale controller

concluded, the data package obtained is transmitted to the PC and evaluated. It can then be printed out in the form of a verification, calibration or test certificate.

The entire method and evaluation are based on current OIML Recommendations (notably R 111) and the weighing data is stored in a database, which remains accessible for the purposes of checking back up on the history of a weight or set of weights.

The Verification Authority of Rhineland-Palatinate took delivery of new hardware at the end of June 2000 and has upgraded to a more recent version of *Scales-net32*. The built-in test monitoring program can now be integrated into the quality management system of the Verification Authority because of the new user-friendly hardware and the extended software package, in addition to the automated evaluation of the measuring results and drawing up of the certificates. ■

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